Magnetic Splitting of Molecular Lines in Sunspots

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A study of molecular lines in sunspots is of particular interest because of their high temperature and pressure sensitivity. Many of them are also magnetically sensitive, but this was not yet widely investigated. With high-resolution, high signal-to-noise Fourier spectroscopy in four Stokes parameters now available, the use of molecular lines for studying the structure of sunspots brings real gains. One is the extension of spot models, including magnetic field, up to layers, where atomic lines suffer from NLTE effects but molecules can still be treated in the LTE approximation. Equally important is the fact that since molecular lines are extremely temperature sensitive they can be used to probe the thermal and magnetic structure of the coolest parts of sunspots. We present calculations of splitting and the Stokes parameters for a number of molecular lines in the visible and near-infrared regions. Our first selections are the green system of MgH $A^2\Pi$–$X^2\Sigma$ and the TiO triplet α, γ' and γ systems as the most studied band systems in the sunspot spectrum. The calculations involve different regimes of the molecular Zeeman effect, up to the complete Paschen-Back effect for individual lines. We look for molecular lines which can be used along with atomic lines to derive magnetic, thermal and dynamic properties of the umbra.

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